How to tell whether a plant is outcrossed, inbred, or hybrid

First, look for the words "hybrid" or "F1" on seed packets. Any plant that has separate male and female flowers is most likely outbred. Plants with closed flowers, such as peas and beans, are usually inbred. Sometimes it will not be obvious whether the plant is inbred or outbred. The following plants are either mostly outcross or inbreed.

Outcrossed

- Beets
- Broccoli
- Cabbage
- Carrots
- Corn
- Cucumbers
- Melons
- Onions
- Radish
- Spinach
- Squash
- Turnips
- Pumpkins
- Most annual flowers

Inbred (self-pollinated)

- Beans
- Lettuce
- Eggplant
- Peas
- Peppers
- Tomatoes
- Clarkia
- Lupine
- Snapdragon
- Stock
- Sweetpea
- Double-flowered asters

Diseases that can be spread through seed from infected plants

- ✓ **Beans, peas, sweet peas:** Anthracnose; bean common mosaic virus; bacterial blight; halo blight; rhizoctonia rots
- ✓ **Cabbage, radish, turnip:** Black rot
- ✓ **All cucurbits (cucumber, muskmelon, watermelon, squash, pumpkin, gourd):** Angular leaf spot (especially cucumber); gummy stem blight; scab; squash mosaic virus
- ✓ **Muskmelon, cucumber, watermelon:** Anthracnose
- ✓ **Solanaceous (eggplant, tomato, petunia, pepper):** Alternaria (early blight); rhizoctonia rot; tobacco mosaic virus; tomato ringspot virus; verticillium wilt
- ✓ **California poppy; nasturtiums:** Leaf spot
- ✓ **Zinnia:** Blight

If you know that your plants have any of these diseases, do not save the seed. However, most people will have no idea whether their plants are infected with particular fungi, bacteria, or viruses. A good rule of thumb is to simply save seed only from plants that have healthy, normal-looking leaves and fruit. As extra insurance, prior to planting, seed from cabbage, eggplant, pepper, and tomato can be carefully immersed in hot water (122 degrees F) for 25 minutes to decrease disease. Both the temperature and timing must be exact to decrease the disease without affecting germination.

References

Breed your own vegetable varieties: the Gardener's and farmer's guide to plant breeding and seed saving, by Carol Deppe (2000). Chelsea Green Pub. Co. http://www.chelseagreen.com/Garden/BreedYourOwnContents.htm

Heirloom Vegetable Gardening: A Master Gardener's Guide to planting, seed saving, and cultural history, by William Woys Weaver (1999). Henry Holt & Co.

International Seed Saving Institute P.O. Box 4619, Ketchum, ID 83340 (208)-788-4363 http://www.seedsave.org issi@seedsave.org

Saving Seeds, the gardener's guide to growing and storing vegetable and flower seeds, by Marc Rogers (1990). Storey Publishing

Seed Saver's Exchange 3076 North Winn Road, Decorah, IA 52101 (319)-382-5872 http://www.seedsavers.org

Seed sowing and saving: Step-by-step techniques for collecting and growing more than 100 vegetables, flowers, and herbs, by Carole B. Turner (Storey's Gardening Skills Illustrated) (1998). Storey Publishing

Vegetable Seed-savers handbook. Available from Seeds of Texas Seed Exchange, P.O. Box 9882, College Station, TX 77842, jackrowe@compuserve.com

For an introduction to genetics: http://www2.mc.maricopa.edu/anthropology/origins/genetics/introgene.html

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Saving seed for next year

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by
Rhoda Burrows
Extension Horticulturist
Horticulture, Forestry, Landscape and Parks Department

For thousands of years, people have saved seed from their plants to grow the following year. While many of us prefer the convenience and reliability of commercial seed, others would like to harvest their own seed in order to save money, to keep plants not easily available from other sources, or just for the intrinsic value of self-sufficiency. Besides, watching plants grow from the seed you collected can be not only educational, but fun!

What plants can I save seed from?

Seed from almost any kind of plant can be saved and grown; however, seed from annuals (plants that flower in the same year that they were planted) are usually the easiest, and least likely to need specialized treatments. Common annuals include vegetables such as peas, beans, tomatoes, peppers, squash, melons, and broccoli, and flowers such as marigolds, zinnias, snapdragons, and petunias.

Sometimes saved seed produces plants that are different from the plant it was saved from. Why does this happen?

Although we grow flowers because we enjoy their appearance, their true function in nature is to form seeds. Two flower parts are essential for seed formation – an egg-containing ovule (found inside the pistil), and pollen (fig. 1). When pollen fertilizes an egg, the seed begins to form. The egg and the pollen each contribute a complete single set of genes (chromosomes), so that the resulting seed (and plant) has two sets of genes. These two sets may be exactly the same or may be very different from each other, and the exact characteristics of the resulting plant will depend on how the two sets of genes interact with each other.

Each egg and pollen grain contain only one of the two sets of genes from the parent plant, and the exact genes in each egg or pollen grain are determined more or less randomly. Thus, different pollen grains (or eggs) from the same plant may contain different genes, and the resulting progeny of different seeds from the same plant may differ if the two sets of genes in the parent were not identical.

Figure 1

SOUTH DAKOTA STATE UNIVERSITY
College of Agriculture & Biological Sciences
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Inbred, outcrossed, and hybrid plants

✔Inbred plants

In inbred plants, the eggs are fertilized with pollen from the same plant. Another term for this is self-pollination. The progeny will each have two identical (or nearly so) sets of genes, exact copies of their parents, and will thus appear very similar to each other. Most peas and beans are inbred. Since seed from a self-pollinated plant will produce plants very like the plant it was produced on, these kinds of plants are ideal for seed saving.

✔Outcrossed plants

Outcrossed plants require pollen from a different plant to fertilize the egg (also called cross-pollination). Some outcrossing species have the female and male parts in separate flowers (corn or squash) or even separate plants (asparagus). Others have both parts in the same flower, but the egg will accept pollen only from another flower or plant. Apples are an example of this – that is why a separate pollinator tree is needed to obtain fruit.

The two sets of genes in progeny of outcrossed plants tend to have a lot of variation, so that the outcome of crossing is less predictable, somewhat like the variation between siblings in a human family.

Seed from outcrossed plants will not necessarily come true; do not save seed from these plants if you want to be certain that the plants will be exactly the same as their parents. However, if you have grown only one variety (and your neighbors have grown the same variety or are far enough away to avoid wind- or insect- cross pollination), you can still save the seed.

✔Hybrid plants

Hybrids result from crossing two different inbred lines. All of the first generation of plants from this cross will contain the exact same two sets of genes (one from each line) and thus will be identical to each other. This first generation is what you buy in a seed packet marked "Hybrid" or "F1".

However, the next generation (the plants that will grow from seed produced from plants grown from "F1" seed) will contain a random mixture of genes, resulting in plants that may have a whole range of desirable and undesirable characteristics. (See below for further explanation). Do not save seed from F1 or hybrid plants if you want to be certain that the plants grown from the seed will be the same as their parents.

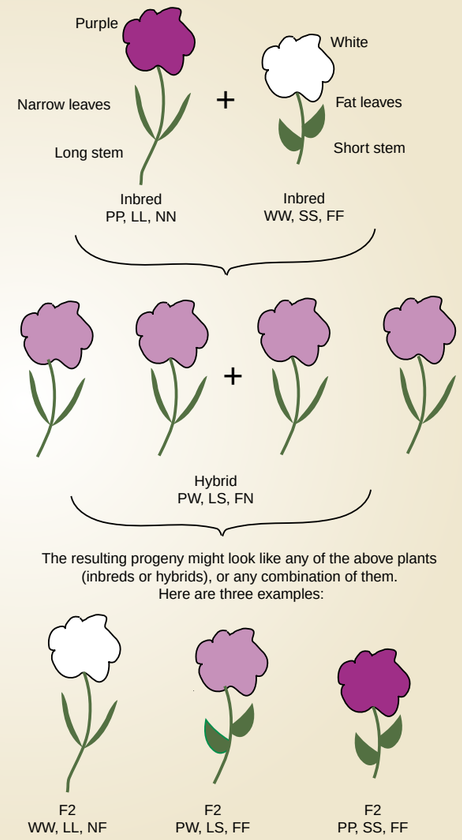
Figure 2

2a.
In this example, we cross two plants with different flower color, leaf shape, and stem length. These parent plants are inbred, so each plant has two identical sets of genes for each characteristic:
P = purple or W = white flower
L = long or S = short stem
N = narrow or F = fat leaf

2b.
All the resulting plants are identical, having light purple flowers (resulting from the combination of P+W), medium stems (resulting from the combination of L+S) and narrow leaves (we'll pretend that N is "dominant" over F). Each of these plants has one gene for each characteristic from each of the inbred parents, so they all have: PW, LS, FN.

2c.
If any two of these plants are crossed, almost anything can result, because each of these plants (known as F1) can pass on either a P or W, L or S, and F or N gene. So the progeny could be any of the following types:

PPLLFF, PPLSFF, PPLSNN, PPLSNF, PPSSNF, PPSSNF, PWLLDD, PWLLFF, PWLSFF, PWLLFN, etc.



How to harvest and save seed

Selecting plants

✓ Determine whether your plants are hybrid, open-pollinated, or self-pollinated (see pg. 4). As discussed above, plants from self-pollinated (inbred) non-hybrid seed are most likely to look like the previous generation. If you are curious and want to see how variable plants from hybrid or open-pollinated parents can be, you can always try them also. You may even discover some good unique plants.

✓ Choose healthy plants in order to avoid seed-borne diseases.

✓ When possible, observe the potential parent plants throughout the whole season.

✓ To keep things simple, start with annuals – plants that produce seed the same season they are planted. Most root crops are biennials (the roots are the way of storing the plant's energy over winter). These must overwinter before they produce seed, and many biennials will not survive our winters in South Dakota. To obtain seed from these crops requires digging the roots in the fall, keeping them in cool (32 to 45 F) storage over winter, and replanting the following spring.

✓ Plants from within the following groups will cross-pollinate each other. Unless you (and close neighbors) have grown only one of the types, you could end up with some very strange vegetables from their seed:

• Squash: Zucchini, crookneck, acorn, vegetable spaghetti, butternut, white bush scallop squash and pumpkins will all cross with each other. Hubbard squash will also cross with butternut, but not other squash. Cucumbers, muskmelon, and watermelon each cross only with themselves, so you don't have to worry about them unless you are growing several varieties of the same thing.

• Broccoli, cabbage, cauliflower, kale, kohlrabi, and brussels sprouts will all cross with each other if they are blooming at the same time.

✓ Don't simply save the last remaining fruit for seed – i.e. don't harvest all your peas or beans and leave the last picking as seed. If you do, you may inadvertently select for a late-growing characteristic, and the seed may be poorer quality than seed allowed to mature during the early or middle of the harvest period.

Plants that grow from seed saved from hybrid plants generally are less vigorous, more variable, and usually have smaller blossoms and yield less than their parents. Why?

Hybrid plants are the result of crossing plants from two different "pure lines" (see Fig. 2a). These pure lines are each a set of plants that have been developed by inbreeding to have consistent characteristics from one generation to the next. Both sets of genes in a pure line plant are identical, or nearly so.

Plant breeders experiment until they find the two lines of inbred parents that will result in the best progeny, for example, a cross that results in plants with the large flowers of one parent, and the disease resistance of the other parent.

When two different pure lines are crossed, the resulting progeny (known as "F1" or first generation) will inherit one set of genes from each parent.

The resulting F1 offspring will be more or less identical, since they are all inheriting the exact same two sets of genes (see Fig. 2b). These progeny usually display "hybrid vigor" – the reason that hybrid plants often have larger flowers or yield more.

However, since it takes time and money to develop the pure lines, and to insure that the flowers of one line are pollinated only by the other line, hybrid seed is usually more expensive.

Because F1 plants contain genes from two different lines, their progeny ("F2" generation) will behave more like outcrossed plants, having a random assortment of the genes from either of the F1 parents – the desired ones along with the bad ones. Some plants may look like the F1 hybrids, but others may look and grow quite differently (see Fig. 2c).

Harvesting seed

The trick is to harvest the seed after it has matured, but before it falls off the plant. While the list below is far from comprehensive, it gives some guidelines for common crops. You may adapt them for crops not listed, or consult one of the more complete references listed at the end.

✓ **Beans, peas**	Allow pods to dry on plant, but harvest before they split open. Shell prior to storage.
✓ **Lettuce**	Seeds don't mature all at once, so collect seed over several time periods by gently shaking the flower head (once white tufts begin to appear) over a paper bag or other collecting device. Seeds will turn dark as they mature. An alternative method of harvest is to cut off the whole seed stalk once it becomes fluffy white, let it dry, and then shake the seed off.
✓ **Tomatoes & Cucumbers**	Pick ripe fruit. Squeeze pulp with seeds into a container, add water and let ferment 2-4 days at room temperature, stirring occasionally. Non-viable (dead) seeds will float. When seeds settle out, pour off pulp. Repeat if necessary to thoroughly clean the seed. When clean, spread seeds out to dry.
✓ **Peppers**	Harvest seed when fruit is thoroughly ripe (most varieties will turn red and begin to shrivel). Remove seed from fruit and allow to dry.
✓ **Melons**	Seed are ripe when fruit is ripe; simply separate out and rinse seed prior to drying.
✓ **Most flowers**	Harvest seed pods or heads when dry.

Storing seed

Once completely dry, seed should be stored in a cool, dry location. If you have room, storing in your refrigerator is ideal. Make sure the storage containers are completely dry.

Envelopes or ziplock bags work fine, as well as baby-food jars, etc. Most seed will stay good for at least 3-4 years. Exceptions are onion and parsnip (1 yr) and corn (2 yrs.). Don't forget to label everything with both the plant name and date!!